DEPARTMENT OF THE ARMY
Omaha District, Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

:NOTICE: Failure to acknowledge : :all amendments may cause rejec- : :tion of the offer. See FAR : :52.215-1 of Section 00100 :	Solicitation No. DACA45-03-R-0049 Date of Issue: 03 FEB 2004 **New** Date of Receiving Proposals: 13 APR 2004

Amendment No. 0002
05 MAR 2004

SUBJECT: Amendment No. 0002 to specification and drawings for Construction of

TEMPORARY LIVING FACILITY / VISITOR'S QUARTERS

Solicitation No. DACA45-03-R-0049

TO: Prospective Offerors and Others Concerned

1. The specifications and drawings for subject project are hereby modified as follows (revise all specification indices, attachment lists, and drawing indices accordingly).

a. Specifications. (Descriptive Changes.)

(1) Project Table of Contents, page 3, under 11450 RESIDENTIAL EQUIPMENT, add the following new item:

"11450A APPLIANCE SCHEDULE".

(2) Project Table of Contents, page 4, delete line "15300 WET PIPE AUTOMATIC FIRE SUPPRESSION SYSTEMS".

(3) Project Table of Contents, page 4, under 15486 FUEL-FIRED DOMESTIC WATER HEATERS, add the following new item:

"15545 CHEMICAL WATER TREATMENT".

(4) Page 00010-1, delete date and time of receiving proposals shown and substitute "13 APR 2004" at "1400".

b. Specifications (New and/or Revised and Reissued). Delete and substitute or add specification pages as noted below. The substituted pages are revised and reissued with this amendment.

Pages Deleted	Pages Substituted or Added
Wage Rate Decision CO030012 (3/20/04)	Wage Rate Decision CO030012 (3/5/04)
Section 08800	Section 08800
Section 13851	Section 13851
Section 15700	Section 15700
Section 16120	Section 16120
Section 16130	Section 16130

Pages Deleted	Pages Substituted or Added
Section 16441	Section 16441
Section 16521	Section 16521
Section 16750	Section 16750
---	Section 11450A
---	Section 15545

c. Drawings (Reissued). The following drawing sheets are revised with latest revision date of March 5 2004, and reissued with this amendment.

(1) Sheet A3.1
(2) Sheet S2.1, Sheet S2.2, Sheet S2.5, Sheet S4.2, Sheet S6.1
(3) Sheet P1.11, Sheet P2.12
(4) Sheet CP001, Sheet CP004
(5) Sheet E2.01, Sheet E5.01, Sheet E5.02, Sheet E7.01

2. This amendment is a part of the proposing papers and its receipt shall be acknowledged on the Standard Form 1442. All other conditions and requirements of the request for proposal remain unchanged. If the proposals have been mailed prior to receiving this amendment, you will notify the office where proposals are received, in the specified manner, immediately of its receipt and of any changes in your proposal occasioned thereby.

a. Hand-Carried Proposals shall be delivered to the U.S. Army Corps of Engineers, Omaha District, Contracting Division (Room 301), 106 South 15th Street, Omaha, Nebraska 68102-1618.

b. Mailed Proposals shall be addressed as noted in Item 8 on Page 00010-1 of Standard Form 1442.

3. Offers will be received until 2:00 p.m., local time at place of receiving proposals, 13 April 2004.

Attachments:
General Wage Decision No. CO030012 dated 5 March 2004
Spec Pages listed in 1.b. above
Dwgs. listed in 1.c. above
Site Visit Attendees List included For Information Only

U.S. Army Engineer District, Omaha
Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

05 March 2004
jdw/4529

General Decision Number: CO030012 03/05/2004 CO12

Superseded General Decision Number: CO020012

State: Colorado

Construction Types: Heavy

Counties: Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Larimer, Mesa, Pueblo and Weld Counties in Colorado.

HEAVY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	06/13/2003
1	08/15/2003
2	09/19/2003
3	10/03/2003
4	12/05/2003
5	01/16/2004
6	02/20/2004
7	03/05/2004

ASBE0028-001 01/01/2004

	Rates	Fringes
Asbestos Workers/Insulator (Includes application of all insulating materials, protective coverings, coatings and finishings to all types of mechanical systems)	$ 19.47	6.25

BRCO0007-006 10/01/2003

ADAMS, ARAPAHOE, BOULDER, DENVER, DOUGLAS, EL PASO, JEFFERSON, AND PUEBLO COUNTIES

	Rates	Fringes
Bricklayer	$ 20.02	8.20

CARP2834-001 05/01/2003

	Rates	Fringes
Millwright	$ 24.49	6.66

ELEC0012-004 09/01/2003

PUEBLO COUNTY

	Rates	Fringes
Electrician	$ 18.98	8.44
Electrical work where the total cost is $200,000 or less		
Electricians:	$ 24.74	8.44
Electrical work where the total cost is over $200,000		

ELEC0068-001 12/01/2003

ADAMS, ARAPAHOE, BOULDER, DENVER, DOUGLAS, JEFFERSON, LARIMER, AND WELD COUNTIES

	Rates	Fringes
Electrician	$ 27.91	9.48

ELEC0111-001 09/01/2002

	Rates	Fringes
Line Construction:		
Groundman	$ 14.05	20.75%+2.30
Lineman	$ 27.36	20.75%+2.30

ELEC0113-002 06/01/2003

EL PASO COUNTY

	Rates	Fringes
Electrician	$ 24.54	3%+11.20

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* ELEC0969-002 12/01/2003

MESA COUNTY

	Rates	Fringes
Electrician	$ 18.40	7.20

ENGI0009-001 05/01/2003

	Rates	Fringes
Power equipment operators:		
Blade: Finish	$ 20.47	6.22
Blade: Rough	$ 20.17	6.22
Bulldozer	$ 20.17	6.22
Cranes: 50 tons and under	$ 20.32	6.22
Cranes: 51 to 90 tons	$ 20.47	6.22
Cranes: 91 to 140 tons	$ 20.62	6.22
Cranes: 141 tons and over	$ 21.38	6.22
Forklift	$ 19.82	6.22
Mechanic	$ 20.32	6.22
Oiler	$ 19.47	6.22
Roller: Self-propelled, all types over 5 tons	$ 20.17	6.22
Roller: Self-propelled, rubber tires under 5 tons	$ 19.82	6.22
Scraper: Single bowl under 40 cubic yards	$ 20.32	6.22
Scraper: Single bowl, including pups 40 cubic yards and over and tandem bowls	$ 20.47	6.22
Trackhoe	$ 20.32	6.22

IRON0024-003 08/01/2002

	Rates	Fringes
Ironworkers: Structural	$ 22.00	7.61

LABO0086-001 05/01/2003

	Rates	Fringes
Laborers:		
Pipelayer	$ 16.29	4.25

PLUM0003-005 01/01/2004

ADAMS, ARAPAHOE, BOULDER, DENVER, DOUGLAS (Northern half), JEFFERSON, LARIMER AND WELD COUNTIES

	Rates	Fringes
Plumber	$ 27.52	7.11

PLUM0020-002 07/01/2003

PUEBLO COUNTY

	Rates	Fringes
Plumbers and Pipefitters		
Free Zone - 0 to 40 miles	$ 20.10	7.57

Zone 1 - 40 miles and over: $19.85 per hour + $32.00 per day per diem will be paid on projects over 40 miles (Zone 1) measured in practical driving miles by the shortest route, beginning at 5th and Main Streets in Pueblo, Colorado, when the employee stays overnight or drives their own vehicle.

Hazardous pay: Add $2.20 per hour to base rate. Hazardous pay applies to projects at chemical plants, steel mills, cement plants, power generator plants, process piping at manufacturing plants, food processing plants, and all projects which may present a health hazard or serious personal injury.

PLUM0058-002 07/01/2003

EL PASO AND DOUGLAS (Southern half) COUNTIES

	Rates	Fringes
Plumbers and Pipefitters	$ 24.95	7.90

PLUM0145-002 05/01/2003

MESA COUNTY

	Rates	Fringes
Plumbers and Pipefitters	$ 21.53	6.95

PLUM0208-004 01/01/2004

ADAMS, ARAPAHOE, BOULDER, DENVER, DOUGLAS (Northern half), LARIMER AND WELD COUNTIES

	Rates	Fringes
Pipefitter	$ 27.47	7.21

SHEE0009-002 07/01/2003

	Rates	Fringes
Sheet metal worker	$ 26.59	9.70

SUCO2001-006 12/20/2001

	Rates	Fringes
Boilermaker	$ 17.60	
Carpenters:		
All Other Work	$ 15.14	3.37
Form Building and Setting	$ 16.97	2.74
Cement Mason/Concrete Finisher	$ 17.31	2.85
Ironworker, Reinforcing	$ 18.83	3.90
Laborers:		
Common	$ 11.22	2.92
Flagger	$ 8.91	3.80
Landscape	$ 12.56	3.21
Painters:		
Brush, Roller & Spray	$ 15.81	3.26
Power equipment operators:		
Backhoe	$ 16.36	2.48
Front End Loader	$ 17.24	3.23
Skid Loader	$ 15.37	4.41

TEAM0435-001 05/01/2000

	Rates	Fringes
Truck drivers:		
Pickup	$ 14.21	5.27
Tandem/Semi and Water	$ 14.93	5.27

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

In the listing above, the "SU" designation means that rates listed under the identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations

Wage and Hour Division

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board

U.S. Department of Labor

200 Constitution Avenue, N.W.

Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

SECTION 08800

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Glass.
- B. Glazing compounds and accessories.

1.2 RELATED SECTIONS
- A. Section 07900 - Joint Sealers: Sealant and back-up material.
- B. Section 08110 - Steel Doors and Frames: Glazed doors and borrowed lites.
- C. Section 08212 - Stile and Rail Wood Doors: Glazed doors.
- D. Section 08410 - Metal-Framed Storefronts.
- E. Section 08510 - Steel Windows: Glazed windows.
- F. Section 10800 - Toilet, Bath, and Laundry Accessories: Mirrors.

1.3 REFERENCES
- A. ASTM C 864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 1999.
- B. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2002.
- C. ASTM C 1036 - Standard Specification for Flat Glass; 2001.
- D. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 1997b.
- E. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass; 1996.
- F. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2000.
- G. ASTM E 773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units; 2001.
- H. ASTM E 774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units; 1997.
- I. ASTM E 1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2002.
- J. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 1997.
- K. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 1990.

1.4 PERFORMANCE REQUIREMENTS
- A. Select type and thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with the applicable building code.
  1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
  2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
  3. Thicknesses listed are minimum.

1.5 SUBMITTALS
- A. See Section 01330 - Submittal Procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit Three samples 6 x 6 inch in size of glass and plastic units, showing coloration and design.
- E. Samples: Submit 3 inch long bead of glazing sealant, color as selected.

1.6 QUALITY CONTROL
- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- B. Vertical roll ripple distortion is not acceptable. All glass bearing such distortion shall be replaced.

C. Horizontal roll ripple distortion shall be minimum, subject to the acceptance of the Owner and Contracting Officer. Unacceptable glass shall be replaced.
D. Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience.

PART 2 PRODUCTS

2.1 FLAT GLASS MATERIALS
A. Manufacturers:
1. AFG Industries, Inc: www.afgglass.com.
2. Guardian Industries Corporation: www.guardian.com.
3. Pilkington Building Products North America: www.pilkington.com.
4. PPG Industries, Inc: www.ppg.com.
5. Visteon Glass Systems: www.visteon.com/floatglass.
B. Clear Float Glass (Type G-1): Clear, annealed.
1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
2. 6 mm minimum thick.
C. Safety Glass (Type S-1): Clear; fully tempered with horizontal tempering.
1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
2. 6 mm minimum thick.
D. Laminated Glass (Type L-1): Clear; fully tempered with horizontal tempering.
1. Laminated with 0.060 inch thick plastic interlayer; comply with ASTM C 1172
2. 7.9375 mm minimum thick.
E. Low E Glass (Type E-1): Float type, heat strengthened, clear.
1. Coating on inner surface.
2. Visible light transmittance of 69 percent, light to solar gain ration of 1.86, shading coefficient of 0.44.
3. Comply with ASTM C 1036, Type I, transparent flat, Quality Q3 (glazing select).
4. 6 mm minimum thick.
F. Low E Glass (Type E-2): Float type, tempered, clear.
1. Coating on inner surface.
2. Visible light transmittance of 69 percent, light to solar gain ratio of 1.86, shading coefficient of 0.44.
3. Comply with ASTM C 1036, Type I, transparent flat, Quality Q3 (glazing select).
4. Comply with ASTM C 1048.
5. 6 mm minimum thick.
G. Wired Glass (Type W-1): Clear.
1. Stainless steel wire in square mesh pattern.
2. 1/2 inch grid size.
3. Comply with ASTM C 1036.
4. Polished both sides.
5. 6 mm minimum thick.

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2.2 SEALED INSULATING GLASS MATERIALS
A. Manufacturers:
1. Any manufacturer incorporating the flat glass materials of the manufacturers above and complying with the additional requirements below. B. Insulated Glass Units (Type I-1): Double pane with glass to elastomer edge seal.
1. Outer pane of E-1 glass, inner pane of L-1 glass.
2. Place low E coating on No.2 surface within the unit.
3. Comply with ASTM E 774 and E 773, Class CBA.
4. Purge interpane space with dry hermetic air.
5. Total unit thickness of 1 inch minimum.
C. Insulated Glass Units (Type I-2): Double pane with glass to elastomer edge seal.

Deleted: Any of the manufacturers listed under Flat Glass Materials.¶

1. Outer pane of E-2 glass, inner pane of L-1 glassNone - N/A.
2. Place low E coating on No.2 surface within the unit.
3. Comply with ASTM E 774 and E 773, Class CBA.
4. Purge interpane space with dry hermetic air.
5. Total unit thickness of 1 inch minimum.

2.3 STAINED GLASS MATERIALS

A. Manufacturer: Bullseye Glass Co., 3722 SE 21st Street, Portland, OR 97702 (503)232-8887

B. 3mm Standard Stained Glass
   1. "Cathedral" single-rolled transparent
   2. "Red Orange"
   3. "Medium Amber"

C. See window type in the Drawings for more information.

D. GLAZING COMPOUNDS
   1. Manufacturers:
   2. Butyl Sealant (Type B): Single component; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; Shore A hardness of 10 to 20; black color; non-skinning.
   3. Polysulfide Sealant (Type PS): Two component; chemical curing, non-sagging type; ASTM C 920, Type M, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.
   4. Silicone Sealant (Type S): Single component; chemical curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color as selected.

E. GLAZING ACCESSORIES
   1. Manufacturers:
      a. Pecora Corporation: www.pecora.com.
      b. Tremco, Inc: www.tremcosealants.com.
   2. Setting Blocks: Silicone, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
   3. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; 1/4 x 3/8 inch size; black color.
   4. Glazing Splines: Resilient 70 durometer Shore A EPDM extruded shape to suit glazing channel retaining slot; ASTM C 864 Option I; black color.
   5. Glazing Clips: Manufacturer's standard type.

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PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

D. Install sealants in accordance with ASTM C 1193 and FGMA Sealant Manual.

E. Install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION - EXTERIOR DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

D. Position glazing tape so that it is 1/8" down from the edge of the fixed glazing leg. Apply cap bead of sealant (compatible with the tape).
E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
F. Trim protruding tape edge.

3.4 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)
A. Place setting blocks at 1/4 points and install glazing pane or unit.
B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
C. Fill gaps between glazing and stops with polysulfide type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.5 INSTALLATION - INTERIOR WET METHOD (COMPOUND AND COMPOUND)
A. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.
B. Locate and secure glazing pane using glazers' clips.
C. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.6 CLEANING
A. Remove glazing materials from finish surfaces.
B. Remove labels after Work is complete.
C. Clean glass and adjacent surfaces.

3.7 PROTECTION OF FINISHED WORK
A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

3.8 SCHEDULE
A. Steel Windows: Type I-1 or I-2 where required, exterior wet method with Type PS compound.
B. Aluminum Storefronts (Interior): Type G-1 or S-1 where required, thicknesses required to comply with performance requirements, exterior dry method.
C. Hollow Steel Frames - Interior: Interior wet method with Type S compound. Exterior: Exterior wet method, with Type PS compound.
    1. Fire-rated openings: Wired glass, Type W-1, 6 mm thick.
    2. Exterior openings: Type I-2, 1-inch thick.
D. Steel Doors:
    1. Fire-rated: Wired glass, Type W-1, 6 mm thick, interior wet method with Type S compound.
    2. Exterior: Type I-2, 1-inch thick, exterior wet method, with Type PS compound
E. Stile and Rail Wood Doors:
    1. Interior: Type W-1, 6 mm thick, interior wet method with Type S compound.

END OF SECTION

SECTION 13851

FIRE ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section covers furnishing the design of a fire alarm system and the furnishing and installation of a fire alarm system, including all associated equipment, devices, controls, wires, and raceways necessary for proper operation

Deleted: includes fire alarm systems

B. The design of the fire alarm system shall consist of, but shall not be limited to, a determination of the applicable fire and safety codes, the number and types of detectors, alarm indicators, manual stations required, and the proper locations, wiring and mounting configurations.

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C. Fire alarm devices and locations shown on the Contract Drawings do not negate the responsibility of the System Supplier to design a system in compliance with all applicable fire and safety codes.

D. Related Sections include the following:

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1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

E. System shall interface with the Buckley Fire Station existing system.

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1.3 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. PE: Colorado Certified Professional Engineer.

E. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

A. Analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.

B. Fire alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Verified automatic alarm operation of smoke detectors.
4. Automatic sprinkler system water flow.
5. Fire extinguishing system operation.
6. Fire standpipe system.
7. Smoke detectors.

C. Fire alarm signal shall initiate the following actions:

1. Alarm notification appliances shall operate continuously.
2. Identify alarm at the FACP and remote annunciators.
3. De-energize electromagnetic door holders.
4. Transmit an alarm signal to the remote monitoring station.
5. Unlock electric door locks in designated egress paths.
6. Release fire and smoke doors held open by magnetic door holders.
7. Activate voice/alarm communication system.
8. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
9. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
10. Record events in the system memory.

D. Supervisory signal initiation shall be by one or more of the following devices or actions:

1. Operation of a fire-protection system valve tamper.

E. System trouble signal initiation shall be by one or more of the following devices or actions:

1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at the FACP.
4. Ground or a single break in FACP internal circuits.
5. Abnormal ac voltage at the FACP.
6. A break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at the FACP or annunciator.
9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

F. System Trouble and Supervisory Signal Actions: Annunciate at the FACP and remote annunciators.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire alarm system design.
   b. Fire alarm certified by NICET, minimum Level III.

c. Colorado Certified Professional Engineer.

2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
3. Device Address List: Coordinate with final system programming.
4. Transmitter Output Schedule.
5. Input/Output Schedule.
6. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
7. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
8. Fire alarm battery calculation.
9. Fire alarm voltage drop calculations.
10. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Floor Plans: Show addresses of each addressable device.
12. Show size and route of cable and conduits.

C. Qualification Data: For Installer.

D. Fire alarm inspection reports.

E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.

F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittal Procedures," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.

1.7 QUALITY CONTROL

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
3. Smoke and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. FACP and Equipment:

   a. Edwards Systems Technology Inc.
   b. Faraday, LLC.
   c. Federal Signal Corporation.
   d. Fire Control Instruments, Inc.; a GE-Honeywell Company.
   e. Fire-Lite Alarms; a GE-Honeywell Company.
   f. Gamewell Company (The).
   g. Grinnell Fire Protection; a Tyco International Company.
   h. Harrington Signal, Inc.
   i. NOTIFIER; a GE-Honeywell Company.
   j. Protectowire Company, Inc. (The).
   k. Radionics; a division of Detection Systems, Inc.; a member of the Bosch Group.
   l. SAFETECH International, Inc.
   m. Siemens Building Technologies, Inc.; a Cerberus Division.
   n. Silent Knight; a GE-Honeywell Company.
   o. SimplexGrinnell LP; a Tyco International Company.

2. Wire and Cable:

   a. Comtran Corporation.
   b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
   c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
   d. West Penn Wire/CDT; a division of Cable Design Technologies.

3. Audible and Visual Signals:

   a. Amseco; a division of Kobishi America, Inc.
   b. Commercial Products Group.
   c. Gentex Corporation.
   d. System Sensor; a GE-Honeywell Company.
   e. Wheelock.

B. Notwithstanding Section 00700 Contract Clauses clause "FAR 52.236-5, Material and Workmanship, the radio alarm transmitter shall be manufactured by Digitize, Inc. in order that the fire alarm system be tied into the existing basewide fire alarm system for remote monitoring.

2.2 FACP

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.
2. Addressable initiation devices that communicate device identity and status.

    a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
    b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

4. FACP shall be compatible with radio alarm transceiver manufactured by Digitize.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Signaling Line Circuits: NFPA 72, Class A, Style 6.

    a. System Layout: Install no more than 100 addressable devices on each signaling line circuit.

2. Notification-Appliance Circuits: NFPA 72, Class A, Style Z.
3. Actuation of alarm notification appliances, emergency voice communications, annunciation, and elevator recall, shall occur within 10 seconds after the activation of an initiating device.
4. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel FACP indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

F. Elevator Controls: Heat detector operation shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.

1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.

G. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

H. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

I. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

J. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.

K. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a radio alarm transmitter.

L. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory signal and digital alarm radio transmitter shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

M. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

1. Batteries: Sealed lead calcium.
2. Battery and Charger Capacity: Comply with NFPA 72.

N. Surge Protection:

1. Install surge protection on normal ac power for the FACP and its accessories.
2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

Deleted: Comply with Division 16 Section "Transient Voltage Suppression" for auxiliary panel suppressors.

O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.3 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
2. Station Reset: Key operated switch.

2.4 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Multipurpose type, containing the following:

   a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
   b. Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
   c. Heat sensor, combination rate-of-rise and fixed temperature.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

   a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F per minute.
   b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 200 deg F.
   c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

   a. Sensor: LED or infrared light source with matching silicon-cell receiver.
   b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.

   a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
8. Each sensor shall have multiple levels of detection sensitivity.
9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
10. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 200 deg F.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Horns: Electric-type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output: As required by location.
2. Strobe Leads: Factory connected to screw terminals.

D. Voice/Tone Speakers:

1. UL 1480 listed.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: Flush, semirecessed, or surface mounted; bidirectional as indicated.
5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

2.7 SPRINKLER SYSTEM REMOTE INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 REMOTE GRAPHIC AND LCD TEXT ANNUNCIATOR

A. Description: Graphic and LCD text annunciator which duplicates functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

C. Graphic annunciator shall include map of facility with LED lights indicating trouble and alarm for the following zones:
   1. Administration Building - Basement
   2. Administration Building - 1st Level
   3. Visitor Quarters (VQ) - 1st Level
   4. Visitor Quarters (VQ) - 2nd Level
   5. Visitor Quarters (VQ) - 3rd Level
   6. Temporary Living Facilities (TLF) - Segment 1
   7. Temporary Living Facilities (TLF) - Segment 2
   8. Temporary Living Facilities (TLF) - Segment 3
   9. Sprinkler System - Administration Building
   10. Sprinkler System - Visitor Quarters (VQ) 1st Level
   11. Sprinkler System - Visitor Quarters (VQ) 2nd Level
   12. Sprinkler System - Visitor Quarters (VQ) 3rd Level
   13. Sprinkler System - Temporary Living Facilities (TLF)

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to a circuit-breaker shunt trip for power shutdown.

2.11 RADIO ALARM TRANSCEIVER

A. Listed and labeled according to NFPA 1221. Comply with 47 CFR 90.

B. Description: Factory assembled, wired, and tested; and ready for installation and operation.

   1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
   2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
   3. Normal Power Input: 120-V ac.
   4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
   5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph with a gust factor of 1.3 without failure.
   6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
   7. Antenna-Cable Connectors: Weatherproof.
   8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.

C. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP or from its own internal sensors or controls, and automatically transmits signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages correspond to standard designations for the fire-reporting system to which the signal is being transmitted and include separately designated messages in response to the following events or conditions:

1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
4. Local Fire Alarm System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
5. Local Fire Alarm System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
6. Local Alarm System Supervisory Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

2.12 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than size as recommended by system manufacturer.

1. Circuit Integrity Cable: Shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 14 AWG, minimum.
2. Line-Voltage Circuits: No. 14 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/FPLP conductor insulation, copper drain wire, copper armor with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed 30 feet.
2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.

3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

D. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

F. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches below the ceiling.

H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

I. FACP: Surface mount with tops of cabinets not more than 72 inches above the finished floor.

J. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

K. Antenna for Radio Alarm Transmitter: Mount to building structure. Use mounting arrangement and substrate connection that will resist 100-mph wind load with a 1.3 gust factor without damage.

Deleted: where indicated

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's

wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Basic Electrical Materials and Methods."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.

2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices.

Deleted: Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 13851

SECTION 15700

AIR SYSTEMS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 7 Section for roof accessories.

C. Division 7 Section “Joint Sealants.”

D. Division 9 Section “Painting.”

E. Division 15 Section “Vibration and Noise Control."

F. Division 15 Section “Air Distribution."

G. Division 15 Section “Testing, Adjusting and Balancing.”

H. Division 16 Section "Enclosed Switches and Circuit Breakers."

I. Division 16 Section "Basic Electrical Materials and Methods."

1.2 SUMMARY

A. This section includes:

1. Fan Coil Units
   a. “High Rise” units with water coils for heating and cooling
   b. Ceiling-mounted units
2. Make-up Air Units: Constant volume, air handling units with coils for indoor installations
3. Power Ventilators
   a. Roof-mounted propeller exhaust fans
   b. Ceiling-mounted exhaust fans

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on actual site elevations.

B. Operating Limits: Classify according to AMCA 99.

C. Fan performance data including capacities, static pressures, motor requirements, and electrical characteristics as indicated.

D. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS

A. Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each model including:

1. Rated capacities of selected models
2. Weights (shipping, installed, and operating)
3. Dimensions
4. Metal gauges
5. Furnished specialties and accessories
6. Data on features and components
7. Installation, rigging, and startup instructions
8. Plan and elevation views
9. Minimum clearances
10. Certified fan performance curves with system operating conditions indicated
11. Certified fan sound power ratings
12. Certified coil performance ratings with system operating conditions indicated
13. Motor ratings and electrical characteristics plus motor and electrical accessories
14. Material gauges and finishes, including color charts
15. Dampers, including housings, linkages, and operators where specified
16. Filters with performance characteristics
17. Product certificates, signed by manufacturers, certifying their products comply with specified requirements

C. Coordination Drawings including floor plans and sections drawn accurately to scale. Submit with shop drawings. Show the following:

1. Fan room and equipment layout and relationships, including floor plans and sections drawn accurately to scale, between components and adjacent structural and mechanical elements.
2. Support locations, type of support, and weight on each support.
3. Certified field measurements.
4. Roof framing and support members relative to duct penetrations.
5. Ceiling suspension members.
6. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

D. Wiring diagrams from manufacturer detailing wiring for power and control systems. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

E. Maintenance Data: Submit maintenance data and parts list for each piece of equipment supplied. Include this data in the operation and maintenance manual specified in Division 1.

F. Submit samples of enclosure finishes and colors for approval.

1.5 QUALITY CONTROL

A. Manufacturer Qualifications: Firm experienced in manufacturing equipment similar to those indicated for this project and that have a record of successful in-service performance. Only manufacturers listed in these specifications for individual components will be considered.

B. Single-Source Responsibility: Obtain air coil components from one source and by a single manufacturer.

C. Codes and Standards:

1. NFPA Compliance: Provide components that comply with NFPA 70 and with NFPA 90A.
2. ASME Compliance: ASME Boiler and Pressure Vessel Code.
3. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
4. ARI Compliance: Test and rate air handling equipment according to ARI.
5. ASHRAE Compliance: Design, construct, and assemble refrigerating system in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
6. NRCA Compliance: Provide roof curbs for roof-mounted equipment constructed according to recommendations of NRCA.
7. UL and NEMA Compliance: Provide ancillary electrical components required as part of energy recovery units that are listed and labeled by UL and that comply with applicable NEMA standards.
8. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA seal.
9. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association applicable standards.
10. ANSI - American National standards Institute Compliance. Provide fan bearings in compliance with ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings. Provide filters in compliance with ANSI/U - 900 Test Performance of Air Filter Units.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver equipment units as factory-assembled, unless otherwise indicated, with protective crating and covering.

B. Coordinate delivery of units in sufficient time to allow movement into building.

C. Handle equipment to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.7 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction. Roof specialties are specified in Division 7 Sections.

B. Coordinate layout and installation of units and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, piping and ductwork, HVAC equipment, fire suppression system components, and partition assemblies.

C. Coordinate layout and installation of air coils with duct, insulation, and with other installations. Revise locations and elevations from those indicated as required to suit field conditions, and as approved by the Architect.

D. Coordinate size and location of concrete housekeeping bases and structural steel support members. Cast anchor-bolt inserts into base. Concrete reinforcement and form work requirements are specified in Division 3 Sections.

PART 2 - PRODUCTS

2.1 FAN COIL UNITS, FLOOR MOUNTED, CHILLED WATER COOLING

A. General: Vertical two-pipe fan coil unit with chilled water cooling.

B. Subject to compliance with requirements, provide products by International Environmental, Inc. or approved equal.

C. Materials

1. Drain Pans: Galvanized steel, with connection for drain. Drain pan insulated with polystyrene or polyurethane insulation.
2. Cabinet: Galvanized steel with removable panels, insulated with 1/2" matte faced glass fiber insulation.
   a. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge, with safety chain.
3. Cabinet Finish: Bonderize, phosphatize, and flow-coat with baked-on primer.

D. Water Coils

1. Fin-and-Tube Coil: Copper tube, with mechanically-bonded aluminum fins spaced no closer than 0.1 inch. Leak test to 300 psig under water.
2. Integral piping risers connected to hot and chilled water coils, factory mounted, with integral expansion compensation, sized as per riser diagrams on drawing.

E. Fan

1. Centrifugal fan, with forward curved, double width wheels of reinforced fiberglass, in galvanized steel fan scrolls, directly connected to manufacturer's standard motor.

F. Accessories

1. Furnish combination starter and disconnect, factory mounted.
2. Wiring Terminations: Match conductor materials and sizes indicated. Connect motor to chassis wiring with plug connection.
3. Discharge grille panels fabricated of galvanized steel with stamped integral grilles and access doors.
4. Filters: 1-inch- thick, throw-away filters in fiberboard frames.
5. Dampers: Steel damper blades with polyurethane stop across entire blade length, operated by factory-mounted electric operators for 25 percent open cycle.

G. Controls: Provided by Controls Contractor as per Section 15900 HVAC Controls.".

Deleted: Packaged, unit mounted, electrical, field installed. Valves to be three-way, on/off for hot water and for chilled water

2.2 FAN COIL UNITS, CEILING MOUNTED

A. General: Ceiling mounted, two-pipe fan coil unit, as shown on drawings.

B. Subject to compliance with requirements, provide products by International Environmental, Inc., or approved equal.

C. Materials

1. Drain Pans: Galvanized steel, with connection for drain. Drain pan insulated with polystyrene or polyurethane insulation.
2. Cabinet: Galvanized steel with removable panels, insulated with 1/2" matte faced glass fiber insulation.
   a. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge, with safety chain.
3. Cabinet Finish: Bonderize, phosphatize, and flow-coat with baked-on primer.

D. Water Coils

1. Fin-and-Tube Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch. Leak test to 300 psig underwater.

E. Fan

1. Centrifugal fan, with forward curved, double width wheels of reinforced fiberglass, in galvanized steel fan scrolls, directly connected to manufacturer's standard motor.

F. Accessories

1. Furnish combination starter and disconnect, factory mounted.
2. Wiring Terminations: Match conductor materials and sizes indicated. Connect motor to chassis wiring with plug connection.
3. Discharge grille panels fabricated of galvanized steel with stamped integral grilles and access doors.
4. Filters: 1-inch- thick, throwaway filters in fiberboard frames.
5. Dampers: Steel damper blades with polyurethane stop across entire blade length, operated by factory-mounted electric operators for 25 percent open cycle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area for compliance with requirements for installation tolerances, housekeeping pads, and conditions affecting installation and performance of equipment being installed.

B. Examine roughing-in of condensate drainage piping, and electrical to verify actual locations of connections and dimensions before installation.

C. Verify that roofing, flooring, and ceiling systems are ready to receive work and opening dimensions are as indicated on Shop Drawings.

D. Verify that power supply is available and of the correct characteristics.

E. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install equipment and accessories according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.

B. Install air coils and duct heaters in metal ducts and casings constructed according to SMACNA "HVAC Duct Construction Standards."

C. Anchor air coils in position using suitable supports.

D. Install piping connections, maintaining manufacturer's recommended clearances for service and maintenance of coils.

E. Install shutoff valves at coil inlet and outlet connections.

F. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.

1. Spring hangers are specified in Division 15 Section "Vibration and Noise Control."

G. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base where installation conditions require.

1. Spring hangers are specified in Division 15 Section "Vibration and Noise Control."

H. Substrate Mounted Units: Provide supports connected to substrate. Secure units to supports.

I. Install units level and plumb, maintaining manufacturer's recommended clearances. Allow clearance for maintenance and service.

J. Curb Support: Install roof curb on roof structure, level, according to NRCA's written installation instructions. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing with roof construction.

K. Unit Support: Install unit on structural curbs and level. Coordinate wall penetrations and flashing with wall construction.

L. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

1. Installation of roof curbs is specified in Division 7.

M. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

N. Ceiling units: Suspend units from structure using steel wire or metal straps.

O. Equipment housekeeping bases as located on drawings.

1. Construct concrete equipment housekeeping pads as follows:

a. Coordinate size of equipment bases with actual unit sizes provided. Construct base 4 inches larger in both directions than the overall dimensions of the supported unit.
b. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
c. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units as required.
d. Clean exposed steel form in accordance with SSPC Surface Preparation Specifications SP 2 or SP 3 and apply two coats of rust-preventive metal primer.

3.3 CONNECTIONS

A. Connect condensate drain pans using copper tubing, ASTM B 88, Type M with streamline drainage fittings and soldered joints. Extend to nearest equipment drain or floor drain. Construct vented, deep trap at connection to drain pan and install cleanouts at changes in direction. Terminate to suit local code requirements, except where stricter methods are indicated.

B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.
2. Temperature control wiring and interlock wiring are specified on drawing schedules.

D. Connect units and components to wiring systems and to ground as indicated and instructed by manufacturer and in accordance with the NEC. Tighten connectors and terminals, including screws and bolts and grounding connections, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A and UL 486B.

3.4 QUALITY CONTROL

A. Start up fan coil units in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Provide the services of a qualified independent testing agency to perform specified field quality control testing.

C. After installing and connecting units, demonstrate product capability and compliance with requirements.

D. Air Handling System:

1. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:
   a. Inspect the field assembly of components and installation of fans including ductwork and electrical connections, alignment of fan shaft and motor shaft, alignment of pulleys, belt adjustments, and lubrication.
   b. Prepare a written report on findings and recommended corrective actions.
   c. Remove and replace malfunctioning units with new units and retest.

3.5 ADJUSTING AND CLEANING

A. After completing system installation, inspect equipment and associated components, including outlet fittings and devices. Remove burrs, dirt, and construction debris, and repair damaged finishes, including chips, scratches, abrasions and mars, to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

B. Comb bent fins on each air coil.

C. Replace filters in each air handling unit, fan coil unit, and cabinet unit heater. Provide an additional set of filters for use by Owner (two sets total).

D. Adjust damper linkages for proper damper operation. Adjust belt tension. Lubricate bearings. Clean unit interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.6 DEMONSTRATION/TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Schedule training with Owner. Provide at least seven (7) days notice to Contractor of training date.
2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
3. Demonstrate operation of equipment. Conduct walking tour of project. Briefly identify location and describe function, operation, and maintenance of each piece of equipment.
4. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
5. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

3.7 START-UP

A. Air Handling Systems

1. Disconnect fan drive from motor. Verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
2. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
3. Disable automatic temperature control operators.
4. Starting procedures for fans:

a. Energize motor. Verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
   1) Replace fan and motor pulleys as required to achieve design conditions.
b. Measure and record motor electrical values for voltage and amperage.

5. Shut unit down and reconnect automatic temperature control operators.

END OF SECTION 15700

SECTION 16120

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related Sections include the following:

1. Division 16 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 CONDUCTORS AND CABLES

A. Manufacturers:

1. Alcan Aluminum Corporation; Alcan Cable Div.

2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC 5**;** solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

E. Multiconductor Cable: Metal-clad cable, Type MC with ground wire, and nonmetallic sheathed cable, Type NM with ground wire.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, metal clad cable, Type MC.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, metal-clad cable, type MC. Type nonmetallic-sheathed cable, Type NM may be used within TCF units.

G. Branch Circuits below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.

I. Fire Alarm Circuits: Per specification section 13851.

Deleted: or

Deleted: Concealed in Concrete and

Deleted: Type THHN-THWN, in raceway

J. Class 1 Control Circuits: Type THHN-THWN, in raceway.

K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."

F. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."

G. Identify and color-code conductors and cables according to Division 16 Section "Basic Electrical Materials and Methods."

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 16120

SECTION 16130

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 7 Section "Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
2. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
3. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney; Unit of General Signal.
9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw or compression type.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe & Plastics Group.
6. Condux International.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; Division of Hubbell, Inc.
12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

F. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.5 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel.
2. Concealed: Rigid steel.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:

1. Exposed: EMT.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

3.2 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

2.

H. Raceways may pass through structural concrete, but shall not be placed in structural concrete.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.

Deleted: <#>Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.¶ ¶ <#>Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.¶ <#>Space raceways laterally to prevent voids in concrete.¶ <#>Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.¶ Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.

Formatted: Bullets and Numbering

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

K. Tighten set screws of threadless fittings with suitable tools.

L. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

N. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

P. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Q. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 16130

SECTION 16441

SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes service and distribution switchboards rated 600 V and less.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Enclosure types and details for types other than NEMA 250, Type 1.
   b. Bus configuration, current, and voltage ratings.
   c. Short-circuit current rating of switchboards and overcurrent protective devices.
   d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY CONTROL

A. Source Limitations: Obtain switchboards through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."

D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250 W per section) to prevent condensation.

D. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MANUFACTURED UNITS

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Protection Div.
3. Siemens Energy & Automation, Inc.
4. Square D.

B. Front-Connected, Front-Accessible Switchboard: Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.

C. Nominal System Voltage: 480Y/277 V.

D. Enclosure: Steel, NEMA 250, Type 1.

E. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

F. Buses and Connections: Three phase, four wire, unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
2. Ground Bus: 1/4-by-2-inch minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Contact Surfaces of Buses: Silver plated.
4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 50 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.

G. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

H. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating: 105 deg C.

2.3 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.

B. Minimum single-impulse current rating shall be as follows:

1. Line to Neutral: 100,000 A.
2. Line to Ground: 100,000 A.
3. Neutral to Ground: 50,000 A.

C. Protection modes shall be as follows:

1. Line to neutral.
2. Line to ground.
3. Neutral to ground.

D. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.

E. Maximum Category C combination wave clamping voltage shall not exceed 1000 V, line to neutral and line to ground on 277/480 V systems.

F. Maximum UL 1449 clamping levels shall not exceed 800 V, line to neutral and line to ground on 277/480 V systems.

G. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.

H. Accessories:

1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
2. Audible alarm activated on failure of any surge diversion module.
3. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I2t response.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [55] [75] percent of rated voltage.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments with I2t response.
   d. Ground-fault pickup level, time delay, and I2t response.
4. Control Voltage125-V, ac.

2.5 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
   a. Phase Currents, Each Phase: Plus or minus 1 percent.
   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
   d. Megawatts: Plus or minus 2 percent.
   e. Megavars: Plus or minus 2 percent.
   f. Power Factor: Plus or minus 2 percent.
   g. Frequency: Plus or minus 0.5 percent.
   h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
   i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
3. Kilowatt hour output pulse module for monitoring by Delta Controls EMCS.

2.6 CONTROL POWER

A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.

B. Install and anchor switchboards level on concrete bases, 4-inch nominal thickness. Concrete base is specified in Division 16 Section "Basic Electrical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

C. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."

B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

Deleted: Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 16441

SECTION 16521

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts, but not mounted on exterior surfaces of buildings.

B. Related Sections include the following:

1. Division 16 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

Deleted: <#>Division 2 Section "Lighting Poles and Standards" for poles and other support structures and for requirements of resistance to wind and ice loads.¶

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1.3 SUBMITTALS

A. Product Data: For each luminaire, arranged in the order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.
2. Luminaire dimensions, effective projected area, details of attaching luminaires, accessories, and installation and construction details.
3. Luminaire materials.
4. Fluorescent and high-intensity-discharge ballasts.
5. Fluorescent and high-intensity-discharge lamps.
6. Electrical and energy-efficiency data for ballasts.

B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

C. Coordination Drawings: Mounting and connection details, drawn to scale, for exterior luminaires.

Deleted: with requirements specified in Division 2 Section "Lighting Poles and Standards."

D. Field quality-control test reports.

E. Operation and Maintenance Data: For luminaires to include in maintenance manuals.

1.4 QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70.

1.5 EXTRA MATERIALS

Deleted: <#>COORDINATION¶ ¶ <#>Coordinate exterior luminaires with mounting and wind load requirements in Division 2 Section "Lighting Poles and Standards."¶ ¶

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A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Ballasts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 10 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 LUMINAIRES, GENERAL

A. Complying with UL 1598 and listed for installation in wet locations.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

2.3 EXTERIOR LUMINAIRES

A. Refer to drawing Luminaire Schedule for fixture types.

2.4 FLUORESCENT LAMP BALLASTS

A. Ballasts shall be suitable for low-temperature environments.

1. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with high-output lamps.
2. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

B. Ballasts for compact lamps shall be suitable for cold-weather starting and shall include the following:

1. Power Factor: 90 percent, minimum.
2. Ballast-Coil Temperature: 65 deg C, maximum.
3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

2.5 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated:

1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F.
4. Open-circuit operation will not reduce average life.

5. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. Auxiliary, Instant-On, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.

C. High-Pressure-Sodium Ballasts: Solid-state igniter/starter with an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
2. Open-circuit operation will not reduce average life.

2.6 FLUORESCENT LAMPS

A. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 3500, averaged rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

1. T4, Double-Twin Tube: Rated 18 W, 1200 initial lumens (minimum).
2. T4, Double-Twin Tube: Rated 26 W, 1800 initial lumens (minimum).

2.7 HIGH-INTENSITY-DISCHARGE LAMPS

A. High-Pressure-Sodium Lamps: NEMA C78.42, wattage and burning position as scheduled, CRI 21 (minimum), color temperature 1900, and average rated life of 24,000 hours.

B. Low-Pressure-Sodium Lamps: NEMA C78.41.

C. Metal-Halide Lamps: ANSI C78.1372, wattage and burning position as scheduled, CRI 65 (minimum), and color temperature 4000.

2.8 FACTORY FINISHES

A. Field Painting Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match process and color of pole or support materials specified in Division 2 Section "Lighting Poles and Standards."

C. Factory-Painted Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Interior Surfaces: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
   a. Color: As selected from manufacturer's standard catalog of colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lamps in each fixture.

B. Luminaire Attachment: Fasten to indicated structural supports.

C. Adjust luminaires that require field adjustment or aiming.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

1. IESNA LM-5.
2. IESNA LM-50.
3. IESNA LM-52.
4. IESNA LM-64.
5. IESNA LM-72.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16521

SECTION 16750

VOICE, DATA, AND VIDEO COMMUNICATIONS CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. Adherence to ANSI/TIA/EIA – 568B is required.

1.2 SUMMARY

A. This Section includes wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice, high-speed data, and video transmission.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. LAN: Local area network.

D. PVC: Polyvinyl chloride.

E. STP: Shielded twisted pair.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: Include data on features, ratings, and performance for each component specified.

B. Shop Drawings: Include dimensioned plan and elevation views of each individual component. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.

1. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.
2. Wiring diagrams. Show typical wiring schematics including the following:
   a. Workstation outlets, jacks, and jack assemblies.
   b. Patch cords.
   c. Patch panels.
   d. Fiber-optic boxes.

C. Cable Administration Drawings: As specified in Part 3.

D. Samples: For workstation outlets, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.

E. Product Certificates: For each type of cable, connector, and terminal equipment, signed by product manufacturer.

F. Qualification Data: For installer, the Communications Cabling contractor will provide the resume and qualifications of all technicians that will perform work on the installation. Depending on the manufacturer/s that are selected all technicians on the project will need to be certified to install all material, to ensure the manufacturer/s warranty is maintained.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For voice and data communication cabling to include emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: System installer must have on staff a Registered Communication Distribution Designer (RCDD), certified by Building Industry Consulting Service International.

B. Source Limitations: Obtain all products except twisted-pair and fiber-optic cables through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

Deleted: <#>Manufacturer Seismic Qualification Certification: Submit certification that distribution racks and their components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:¶
¶
<#>Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. Indicate whether withstand certification is based on actual test of assembled components or on calculation.¶
<#>The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."¶
<#>The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."¶
<#>Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type, and locate and describe mounting and anchorage provisions.¶
<#>Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.¶

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Deleted: <#>Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.¶
¶
<#>Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.¶ ... [1]

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1.6 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN equipment suppliers. Coordinate service entrance arrangement with local Buckley Base Communications.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces. Any design changes from those specified on the Drawings or Specifications must be approved by Owner, or its designated agent.
2. Record agreements reached in meetings and distribute to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment. The design and location of distribution frames, cross-connect and patch panels in equipment rooms and the space requirements of telephone switch and LAN equipment will be shown on the drawings. Materials change will need to be approved by Owner.

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1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, packaged with protective covering for storage and identified with labels describing contents.

1. Cable: 250 feet (76 m) of each size and type used for Project. Furnish on reels.
2. Patch-Panel Units: One of each type for every six installed, but no fewer than one.
3. Connecting Blocks: One of each type for every 25 installed, but no fewer than one.
4. Outlet Assemblies: One of each type for every 25 installed, but no fewer than one.
5. Furnish two of all punch-down tools used to terminate cable.
6. Furnish 5Extra protector modules for protector.
7. Patch Cords, Fiber and Category 5E: One for every 25 drops installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cable:
   a. Belden Inc.; Electronics Division.
   b. Berk-Tek; an Alcatel Company.
   c. Brand-Rex Co.; Unit of BICC Cables Corp.
   d. Champlain Cable Corporation.
   e. Chromatic Technologies, Incorporated.
   f. General Cable Corporation.
   g. HeLix/HiTemp Cables, Inc.
   h. ICC.
   i. Lucent Technologies; Global Service Provider.
   j. Mohawk/CDT; a division of Cable Design Technologies.
   k. Montrose/CDT; a division of Cable Design Technologies.
   l. Optical Cable Corporation.
   m. Panduit Corp.
   n. Prestolite Wire Corp.

Deleted: <#>Manufacturers: Subject to compliance with requirements, provide products by one of the following:¶
¶

o. Remee Products Corp.
p. Siecor.
q. Superior Essex; Superior Telecommunications Inc.
r. Avaya.
s. Corning.
t. Comscope.

2. Terminal and Connector Components and Distribution Racks:
   a. AMP Incorporated; a Tyco International Ltd. Company.
   b. Hubbell Premise Wiring.
   c. Leviton Telecom.
   d. Lucent Technologies; Global Service Provider.
   e. Panduit Corp.
   f. Thomas & Betts Corporation.
   g. Avaya.

2.2 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. Expansion Capability: Unless otherwise indicated, provide spare fibers and conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase in active workstations.

2.3 MOUNTING ELEMENTS

A. Cable Trays: A wire basket type of runway is required. A B-Line WB99R or equivalent is required that is 12" wide. The cable tray must be installed to meet manufacturer's recommendations on installation.

Deleted: Comply with Division 16 Section "Cable Trays."

B. Raceways and Boxes: Comply with Division 16 Section "Raceways and Boxes."

C. Backboards: 3/4-inch, interior-grade, fire-retardant-treated plywood.

D. Distribution Racks: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported. Provide as specified in the construction drawings.

1. Approximate Module Dimensions: 84 inches high by 22 inches wide.
2. Finish: Baked-polyester powder coat.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Cables: Listed as complying with Category 5E drop cables will be used for all voice and data drops. Category 3 24 AWG plenum-rated riser twisted pair cables will be used as riser cables. Refer to TIA/EIA-568-B for details.

B. Conductors: Solid copper.

C. UTP Cable: Comply with TIA/EIA-568-B. Four, thermoplastic-insulated, individually twisted pairs of conductors; No. 24 AWG, color-coded; enclosed in plenum jacket.

D. UTP and Plenum Cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, UTP cable, workstation cable except materials are modified as required for listing.

E. UTP Cable Connecting Hardware: Comply with TIA/EIA-568-A. IDC type, using modules designed for punch-down caps or tools.

1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
2. IDC Connecting Hardware: Consistent throughout project.

F. Cross-Connect Panel: Modular array of 110 terminal blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Mounting: May be mounted on backboard or in equipment rack as specified on drawings.

G. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable.
2. Mounting: Rack or as specified on drawings.

H. Jacks and Jack Assemblies for UTP Cable: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use non-keyed jacks for data service. Jacks must be Category 5E compatible.

I. UTP Patch Cords: Four-pair cables in 48-inch lengths or length required for installation, terminated with RJ-45 plug at each end must be Category 5E compatible. Use keyed plugs for data service.

J. Workstation Outlets: Dual- or single-jack connector assemblies as specified in construction drawing mounted in single-gang faceplate.

1. Faceplate: High-impact plastic; color as selected by Architect.
2. Mounting: Flush, unless otherwise indicated.
3. Legend: Labeled as specified on drawings.
4. The color of the RJ 45 jacks is specified in the drawings depending on use voice/data and Government vs. House service.

2.5 FIBER-OPTIC CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Cables: Factory fabricated, jacketed, low loss, glass type, fiber-optic, multi-mode, 50 micron graded index, operating at 850 and 1300 nm. A hybrid 12 multi-mode, 50 micron and 12 single-mode, fiber-optic, plenum-rated cable will be installed between the Government communications room and each of the other communications rooms. This cable will be installed in a plenum-rated innerduct.

B. Plenum Cable: Will be used for all inside locations where moisture is not present. Any fiber cable installed in underground conduit will be underground fiber cable.

C. Cable Connectors: SC couplers with self-centering, axial alignment mechanisms. SC connectors will be used for the single-mode fiber. ST connectors will be used for the multi-mode fiber.

D. Patch Panel: Modular panels housing multiple-numbered, duplex cable connectors.

1. Permanent Connection: Permanently connect one end of each connector module to installed cable fiber.
2. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to satisfy specified expansion criteria 20%.
3. Mounting: Rack, or as specified on drawings.

E. Patch Cords: Dual fiber cables in 36-inch lengths or as required by installation configuration.

1. Terminations: Two duplex connectors arranged to mate with patch-panel connectors, one at each end of each fiber in cord.

F. Single-mode fiber cables will also be installed. Single-mode fiber will be terminated on SC-type connectors.

2.6 VIDEO CABLING

A. The backbone video will be plenum-rated RG11 coaxial cable. There will be one RG11 cable from each communications room to the main communications room. This will provide a path for the signal to/from all drops served by the specific communications room.

B. The drop cables will be plenum-rated RG6 coaxial cable terminated in an F-type female connector at the station end. All TV drops will be a plenum-rated RG6 cable with a dedicated home run cable to the serving communications rooms. It will be the responsibility of the contractor to provide taps, splitters, amplifiers etc. at each communications room so that the signals are at the levels specified by the cable TV provider. Reverse channel capability is required.

C. The Contractor shall address the costing of a limited basic and tier-1 service, which will include all services required by the rules of the Federal Communications Commission and any other federal law or regulation, educational access channels, and government access channels, and retransmission of locally broadcast television signals and, when applicable, high-speed internet connectivity. The limited basic and tier-1 service is to be provided.

D. The Contractor shall address the cost to include, as a minimum, local programming, educational, news, children, and public affairs programming.

E. The Contractor will perform initial television line-up.

F. The Contractor will include an FM stereo channel line-up.

G. The Contractor shall include the cost of providing the capability to provide high-speed Broadband Internet service as an option.

H. Channel Capacity. The system shall provide a minimum of 72 channels (6 Mhz or equivalent technology), capable of delivering to subscribers the entire VHF and FM spectrums and selected portions of the UHF spectrum. The system also needs to allow the Government to have one Command Channel for non-commercial use by the Government and one Educational Access Channel for non-commercial use by the Government. The system shall be designed and constructed to permit the Buckley AFB Command Post of Public Affairs to originate transmit messages on all channels. These channels will be also need to be secured so that viewing cannot be outside the Base network viewing system.

I. Emergency Override System. The system shall provide the Government one Emergency Override System on the Base cable television system for emergency use by the Government. The system shall be designed and constructed to permit the Buckley AFB Command Post or

Public Affairs to originate transmit messages on all channels. The system shall not allow any Emergency Override messages to be viewed or heard outside of the Base network viewing system. The service is to be an initial audio interruption with ticker-tape banner scrolling at the bottom of the video screen.

J. Peripheral Equipment. The system provided to the Government will be a reverse video and audio feed path, receiver equipment and facilities for use by the Government in operating the Emergency Override System, Command Channel, and the Educational Access Channel.

K. Technical Requirements/Standards. The Contractor shall ensure that the design meets or exceeds the technical standards required or recommended by the FCC, as set forth in 47 CFR Part 76, as that part exists on the effective date of this Agreement. These standards are mandatory and shall apply to all classes of television channels.

2.7 IDENTIFICATION PRODUCTS

A. Comply with Division 16 Section "Basic Electrical Materials and Methods" and the following:

1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION OF MEDIA

A. Backbone Cable for Data Service: Use 50-micron, laser-optimized multi-mode cable for runs between communications rooms.

B. Single-mode fiber will also be utilized on the backbone. Note: When single-mode and multi-mode fiber are required on the same run, a composite cable may be used.

C. Backbone Cable for Voice Service: Use UTP Category 3 cable for runs between equipment rooms.

D. Horizontal Cable for Data Service: Use UTP Category 5E cable for runs between communications rooms and workstation outlets.

E. Horizontal Cable for Voice Service: Use UTP Category 5E cable for runs between communication rooms and workstation outlets.

F. The single-mode fiber will be terminated in SC connectors in patch panels and the multi-mode fiber will be terminated in patch panels on ST connectors.

G. All cable will be plenum rated.

3.3 INSTALLATION

A. Wiring Method: Install wiring Category 3 riser cable in raceway, cable tray, or conduit provided as shown on project drawings.

B. Wiring Method: Install optical fiber cable in innerduct, conduit, or an armored cable may be used. The conduit or innerduct may be installed on raceway or tray. Use UL-listed, plenum-rated cable for all inside fiber cable.

C. Install cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.

D. Install cables without damaging conductors, shield, or jacket.

E. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

F. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips that will not damage media or raceway.

G. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

H. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

I. Wiring within Communications Rooms: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use waxed cord to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer. Bundle per manufacturers recommendations. Under no circumstances are the outer jacket or sheath to be deformed. Provide service loops as follows: At drop locations 10". In communications rooms provide 10" service loop for Category 5E cables used for data, and cable used for voice will be long enough they can be terminated in a patch panel if required with a 10” service loop at each communications room.

J. Separation of Wires: Comply with TIA/EIA-569-A rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines and equipment.

K. All drops will be continuous, with no splices or taps between the communications rooms and the drop locations.

L. Entrance facilities. Four 4” conduits will be provided from the Government Communications Room in the basement of the Administration Building to the serving manhole. Two of the 4” conduits will be empty. The other two conduits will have 4 1” innerducts installed in each conduit. A 100-pair, 24 AWG, twisted-pair cable will be installed from the Government Communications Room in the basement of the Administration Building to the serving manhole.

3.4 GROUNDING

A. Comply with Division 16 Section "Grounding and Bonding."

B. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Bond shields and drain conductors to ground at only one point in each circuit.

D. Signal Ground Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.

E. Signal Ground Bus: Mount on wall of main equipment room with standoff insulators. The Electric Motion Company, Inc. Ground Bus Bar or equivalent is required. Electric Motion EMG AT 14420 BIM which is a ¼" thick, by 4" wide by 20" long with wall mounting brackets and insulators.

F. Signal Ground Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.5 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

A. Install plywood backboards on walls of equipment rooms and wiring closets from floor to ceiling. Use ¾" fire retardant plywood, painted with white fire retardant paint.

B. Mount patch panels in equipment racks, terminal strips on backboards, and other connecting hardware on backboards, unless otherwise indicated.

C. Group connecting hardware for cables into separate logical fields.

D. Use patch panels to terminate cables entering the space, unless otherwise indicated.

E. Install 19" equipment racks as shown on drawings. Each equipment rack will be provided with a 20-amp AC, 2-receptacle electrical outlet on a non-switched circuit. A power strip will be provided if more that 2 receptacles are required.

3.6 INSTALLATION STANDARDS

A. Comply with requirements in TIA/EIA-568-B and TIA/EIA-569-A.

3.7 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Division 16 Section "Basic Electrical Materials and Methods " and TIA/EIA-606.

B. System: Use a unique, three-syllable, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with same designation. Use logical and systematic designations for facility's architectural arrangement.

1. First syllable identifies and locates equipment room or wiring closet where cables originate.
2. Second syllable identifies and locates cross-connect or patch-panel field in which cables terminate.

3. Third syllable designates type of media (copper or fiber) and position occupied by cable pairs or fibers in field.

C. Workstation: Label cables within outlet boxes.

D. Distribution Racks and Frames: Label each unit, and field within that unit.

E. Within Connector Fields in Communications Rooms: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service. The color for jacks is specified on the drawings.

F. Cables, General: Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet, junction or outlet box, and elsewhere as indicated.

G. Outlets and patch panel labeling. As a minimum, outlet and patch panel labeling must show the TC room number serving the outlet and the outlet circuit number. The outlet number should reflect its relative physical location in the building, such as a room number. Circuit numbers should not incorporate telephone extension numbers since telephone numbers can be reassigned to different outlets in telephone switching equipment and are therefore subject to frequent change. Where several patch panels are located in a single TC, the numbering and labeling scheme must also show the number of the patch or upper jack position must be designated for and labeled "PHONE," and the bottom jack position must be designated for and labeled "DATA" and "SPARE". All patch panels terminating copper cable must be stenciled with the panel number, the cable count, and whether terminations are wired to TIA/EIA-568-B termination configuration, T568A (by exception only), or T578B (default) wiring standard. Fiber-optic ports in patch panels must be labeled to show the transmit "TX" and receive "RX" port for each duplex set of fibers. Lettering on labels must be 6 millimeters (0.25 inch) high and machine made; handwritten labels must not be used for permanent installation. Cable labels must be 18 inches from the end of the cable to allow for maintenance cuts.

H. Distribution System Labeling. All transitions and changes in distribution system size and type shall be labeled on the as-built drawings. Each cabinet, patch panel, and cable termination shall be labeled.

I. Grounding and Bonding. All grounding and bonding conductor cables will be labeled with an alphanumeric identifier and warning label a described in EIA/TIA – 606.

J. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

K. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for project, in software and format selected by Owner.

L. Cable Administration Drawings: Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications rooms, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606. Furnish electronic record of all drawings, in software and format selected by Owner.

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

Deleted: <#>Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.¶
¶
<#>Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:¶
¶

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1. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
2. Copper Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bi-directional, Category 5E tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-TSB67, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems." Link performance for UTP cables must meet minimum criteria of TIA/EIA-568-B. All test results will be provided to the owner or the owner's agent. Tests must be done to ensure that the manufacturers 25-year warranty is valid. All warranty information will be provided before system is turned over. The owner or owner's representative has the right to insist that under supervision of owner or owner's representative the contractor provide test equipment and personnel to verify test records. It will be the contractor's responsibility to ensure all drops are compliant with accepted standards. The owner or owner's agent may engage a third party to verify test results.
3. Fiber-Optic Cable Procedures: Perform each visual and mechanical inspection and electrical test, including optional procedures, stated in NETA ATS, Section 7.25. Certify compliance with test parameters and manufacturer's written recommendations. Test optical performance with optical power meter capable of generating light at all appropriate wavelengths. An OTDR and power meter test will be required. An attenuation test will be required on all single- and multi-mode fiber-optic cables. All test results will be provided to the owner or the owner's agent. Tests must be done to ensure that the manufacturer's 25-year warranty is valid. All warranty information will be provided before system is turned over. The owner or owner's representative has the right to insist that under supervision of owner or owner's representative the contractor provide test equipment and personnel to verify test records. It will be the contractor's responsibility to ensure all drops are compliant with accepted standards. The owner or owner's agent may engage a third party to verify test results. A hard copy and an electronic file copy of all test results is required.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

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3.9 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and extending wiring to establish new workstation outlets. The contractor will provide two of each type of punch-down tools used on the project.

Deleted: Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 16750

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Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

TLF Appliance Schedule

Appliance Type	Mfg/Model	Remarks	Qty	MSRP
Non-Accessible Units				
Dishwasher	Whirlpool DU850SWLQ *(Energy Star Qualified)*	Contractor shall furnish this appliance with the "Hi-Temp Wash Cycle" option	28	$269
Garbage Disposer	Whirlpool GC2000PE		28	$90
Range Vent Hood (exhaust fan)	GE JV635CWW		28	$289
Range with Oven	Whirlpool RF378LXMQ		28	$649
Refrigerator	Whirlpool ET5WSEXKQ *(Energy Star Qualified)*	Contractor shall also furnish and install this appliance with a water filter and ice maker.	28	$529
Washer/Dryer	Whirlpool LTE6234DQ		28	$1,048
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a
Accessible Units				
Cooktop	GE JP350TCWW		2	$679
Dishwasher	ASKO D3120 *(Energy Star Qualified)*	Color: White	2	$739
Dryer	GE DSXH43EAWW		2	$439
Garbage Disposer	Whirlpool GC2000PE		2	$90
Oven	Frigidaire GLEB27S7A	Color: White. Reversible side swing door	2	$749
Range Vent Hood (exhaust fan)	GE JV635CWW		2	$289
Refrigerator	Whirlpool ED2VHGXMQ *(Energy Star Qualified)*	Contractor shall also furnish and install this appliance with a water filter.	2	$899
Washer	GE WSXH208AWW *(Energy Star Qualified)*		2	$749
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a

Mfg – Manufacturer MSRP – Manufacturer's Suggested Retail Price Qty – Quantity

NOTES:

1. The construction contractor is responsible for buying/ordering, receiving, handling, storage, and installation of appliances.
2. Appliances shall meet Energy Star program standards and specifications.
3. The construction contractor shall submit cut/data sheets of proposed equivalent/substitution appliances for review and approval.
4. All appliance items scheduled above shall be the product of a single manufacturer and of an identical model number and color. Mixed lots or multiple manufacturers, model numbers, or colors for any given appliance type is unacceptable.

VQ Appliance Schedule

Appliance Type	Mfg/Model	Remarks	Qty	MSRP
Non-Suites (accessible and non-accessible)				
Refrigerator	Summit Appliance BI-540	Color: White. Contractor shall also furnish and install custom door panel to match wood cabinets.	114	$895
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a
Non-Accessible Suites				
Washer/Dryer	ASKO Professional Series TDC-44 (Dryer) and WMC-55P (Washer)	Ventless dryer. Install washer/dryer as a stackable unit.	5	$2,195
Refrigerator	Summit Appliance BI-540	Color: White. Contractor shall also furnish and install custom door panel to match wood cabinets.	5	$895
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a
Accessible Suite(s)				
Washer/Dryer	ASKO Professional Series TDC-44 (Dryer) and WMC-55P (Washer)	Ventless dryer. Install washer/dryer as side-by-side units.	1	$2,195
Refrigerator	Summit Appliance BI-540	Color: White. Contractor shall also furnish and install custom door panel to match wood cabinets.	1	$895
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a
Common Laundry Room (Rooms V103, V203, and V303)				
Dryer	GE DSXH43EAWW		9	$439
Dryer (accessible)	GE DSXH43EAWW		1	$439
Washer	GE WSXH208AWW *(Energy Star Qualified)*		9	$749
Washer (accessible)	GE WSXH208AWW *(Energy Star Qualified)*		1	$749
Ice Dispensing Machine/Ice Dispenser/Water Filter/Automatic Cleaning System/Slime Inhibitor System	Manitowoc QD-0452A (ice cube machine) QPA-310 (dispenser) Arctic Pure AR-20000 (water filter) AuCS A (automatic cleaning system) Guardian GSI200 (slime inhibitor)		3 3 3 3 3	$3,520 $4,150 $413 $495 $140
Laundry Detergent Vending	GF/CI (Government Furnished/Contractor Installed)		n/a	n/a

Mfg – Manufacturer MSRP – Manufacturer's Suggested Retail Price Qty – Quantity

NOTES:
1. The construction contractor is responsible for buying/ordering, receiving, handling, storage, and installation of appliances.
2. Appliances shall meet Energy Star program standards and specifications.
3. The construction contractor shall submit cut/data sheets of proposed equivalent/substitution appliances for review and approval.
4. All appliance items scheduled above shall be the product of a single manufacturer and of an identical model number and color. Mixed lots or multiple manufacturers, model numbers, or colors for any given appliance type is unacceptable.

Administration Building Appliance Schedule

Appliance Type	Mfg/Model	Remarks	Qty	MSRP
Break A010				
Dishwasher	Whirlpool DU850SWLQ *(Energy Star Qualified)*	Contractor shall furnish this appliance with the "Hi-Temp Wash Cycle" option	1	$269
Garbage Disposer	Whirlpool GC2000PE		1	$90
Refrigerator	Whirlpool ED2VHGXMQ *(Energy Star Qualified)*	Contractor shall also furnish and install this appliance with a water filter.	1	$899
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a
Coffee Lounge A120				
Dishwasher	Whirlpool DU850SWLQ *(Energy Star Qualified)*	Contractor shall furnish this appliance with the "Hi-Temp Wash Cycle" option	1	$269
Refrigerator	GE GTH22SHPBS *(Energy Star Qualified)*	Contractor shall also furnish and install this appliance with a water filter.	1	$1,229
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a
Break A130				
Garbage Disposer	Whirlpool GC2000PE		1	$90
Refrigerator	Whirlpool ED2VHGXMQ *(Energy Star Qualified)*	Contractor shall also furnish and install this appliance with a water filter.	1	$899
Microwave	GF/GI (Government Furnished/Government Installed)		n/a	n/a

Mfg – Manufacturer MSRP – Manufacturer's Suggested Retail Price Qty – Quantity

NOTES:
1. The construction contractor is responsible for buying/ordering, receiving, handling, storage, and installation of appliances.
2. Appliances shall meet Energy Star program standards and specifications.
3. The construction contractor shall submit cut/data sheets of proposed equivalent/substitution appliances for review and approval.
4. All appliance items scheduled above shall be the product of a single manufacturer and of an identical model number and color. Mixed lots or multiple manufacturers, model numbers, or colors for any given appliance type is unacceptable.

SECTION 15545

CHEMICAL WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 15010 - Basic Mechanical Requirements.

1.2 SCOPE

A. Engage a Water Treatment Subcontractor to furnish water treatment equipment and to provide water treatment service for a period of one year from date of start up.

B. Provide equipment and services necessary and reasonably incidental to proper completion of Water Treatment Systems shown on Drawings and specified herein, except where specifically noted as being furnished under other Sections of Specifications.

C. Installation of water treatment equipment.

D. Complete water treatment service for the following systems:

1. Evaporative condenser water.
2. Heating hot water.
3. Chilled water.

1.3 SUBMITTALS

A. Submit operation and maintenance data under the provisions of Division 1.

B. Equipment: Submit product data on all products specified hereunder to include physical dimensions, configuration, materials of construction, mechanical and electrical performance and other information as required to demonstrate compliance with these Specifications.

C. Submit product data indicating chemical treatment materials, chemicals, and equipment. Include information on materials of construction, temperature and pressure ratings, and electrical characteristics and requirements.

D. Submit Material Safety Data Sheets (MSDS) for each proposed treatment chemical.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems. Discharges from chemically treated systems to storm or sanitary sewers shall not result in contaminant levels which are in excess of the standards set forth in these regulations.

1.5 MAINTENANCE SERVICE

A. Provide sufficient chemicals for treatment and testing during contract period.

B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

C. Provide laboratory and technical assistance services for contract period.

D. Include two-hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at startup of systems.

E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.6 WARRANTY

A. Submit a written warranty, stating that the system of treatment prevents corrosion, scale formation and slime and algae growth and is compatible with the materials in construction of component parts of system, such as pumps, pump seals, valves, piping, equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Aqua-Chem
2. Betz Industrial
3. Calgon
4. Chem-Treat
5. CSI Industrial Water Treatment.
6. ECO Lab
7. H-O-H Chemical

2.2 EVAPORATIVE CONDENSER WATER SYSTEM

A. Provide chemical feeding equipment on evaporative condenser water within the packaged chiller enclosure to introduce chemicals into system only when system is operating. Provide chemical feed pump, solution tanks, solenoid valves, controls, timers, meters, feeders, etc. as required to connect to the manufacturer provided stubbed connections to maintain the following conditions:

1.	pH	7.0 to 9.0
2.	Organic Inhibitor (as molybdate)	5-10 PPM
3.	Cycles of Concentration*	4 maximum
4.	Organic Growths	None
5.	Dispersant	As required

*Actual cycles of concentration to be determined from analysis of the make-up water.

B. Chemical feed equipment for the condenser and chilled water system shall include the following:

1. Controlled volume chemical feed pump - Dresser, Pulsafeeder, Morr. (115/1/60 power).

2. Thirty five gallon polyethylene biocide and inhibitor solution tanks with wall mounted pumps and pressure relief valves.
3. Solenoid valve for bleed-off.
4. Pressure or flow switch and timer for control of pump operation.
5. Pre-wired control panel for automatic control of chemical feed and bleed-off, housed in a NEMA 1 enclosure with a viewing window on the door. The panel contains a solid state temperature compensated conductivity controller with an instant analog readout dial indicating conductivity level, pilot lights for power, flow, feed and bleed and an integral solid state timer controlling chemical feed pump operation. Include a pre-piped strainer, sensor and flow switch mounted on the side of the enclosure.
6. Contact head water meter located in make-up line to cooling tower.
7. Include low level pilot light and auxiliary contacts for controls furnished under Section 15900.
8. Filter system: Filter shall remove water borne sediment to 10 μm. Filter shall be sized for 5% of condenser water flow. PVC type filter body with replaceable filter, automatic purge system and adjustable purge timed delay setting suitable for a working pressure of 175 psig.

2.3 CLOSED HYDRONIC SYSTEMS

A. By-pass (pot) feeders: One bypass feeder on each system sized for system make-up, with isolating and drain valves, quick opening cap suitable for a working pressure of 175 psig.

1. Introduce closed system treatment through bypass feeder when required or indicated by test.
2. Performance: Water treatment sized and equipped to treat raw water available at Project site to sustain the following water characteristics:

a. Hardness: 0.00.
b. Iron: 0.00.
c. Total Dissolved Solids (TDS): 1500 to 1750 ppm (as CaCO3).
d. Silica: 60 ppm or less.
e. pH: 10.5 or above.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Arrange with Water Treatment Subcontractor to obtain water sample, make a chemical analysis of same for pH, total alkalinity, hardness, total solids, chloride and silica and to submit for approval a description of proposed chemicals which will be used to treat system. Do not use chromates in Water Treatment System.

3.2 CLEANING SEQUENCE

A. Add sufficient detergent and dispersant to remove all dirt, oil and grease closed systems, at concentration as recommended by manufacturer.

B. Hot Water Heating Systems: Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed, and water sample pH is less than 8.0.

C. Chilled Water Systems: Circulate for 48 hours, then drain systems as quickly as possible. Refill with clean water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed, and water sample pH is less than 8.0.

D. Flush open systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 CONDENSER WATER SYSTEM TEST FOR BACTERIA

A. When the cooling tower operates, perform monthly tests of the cooling tower water for legionella pneumophilia. Tests shall be conducted during construction and for one season after final acceptance of system. Submit report stating bacteria count per milliliter and the result from previous months. Forward report to the Architect and Owner.

END OF SECTION

Solicitation Number: DACA45-03-R-0049
Temporary Lodging Facility/ Visiting Quarters (TLF/VQ)
Buckley AFB, CO
Contractor Site Visit
Vist Date: 26 February 2004, 1 PM
Point of Contact: Corey Magstadt, US Army Corps of Engineers
Contact Phone Number: 303-367-0307, cell 720-201-8576

Company	**Name**	Phone Number
Active Plumbing & Heating Inc.	Robert A. Sanchez	719-635-2519
Active Plumbing & Heating Inc.	Joe Paul Morris	719-635-2519
Active Plumbing & Heating Inc.	Daniel J. Pelo	719-635-2519
Active Plumbing & Heating Inc.	James C. Foster	719-635-2519
Alliance Construction Solutions	Scott E. Cadwallader	970-663-9700
Alliance Construction Solutions	Timothy Andrew Nielsen	970-663-9700
Alliance Construction Solutions	Robert Garbrick	970-663-9700
All American Electric	Brandy Chere Williams	303-341-9700
Anderson Construction	Martin Fullmer	402-650-0328
Anderson Construction	John Killingsworth	402-650-0328
Arrcon Electric Inc.	Reagan E. Redd	303-733-5907
Arrcon Electric Inc.	Floris K. Redd	303-733-5907
BearKing, LLC	Ken Szeliga	303-257-4754
BenDo Volt Construction LLC	Jason C. Osterburg	303-216-0814
Cambria Corporation	Richard J. Ritter	303-534-4549
Cambria Corporation	Daniel L. Norris	303-534-4549
CVE Canyon Valley Electric	Robert T. Marchetti	720-851-5624
Cobb Mechanical Contractors	Kenneth F. Nowack	719-471-8958
CommScope	Bruce Richard Markling	303-906-5616
Digatron	John M. Jennen	303-455-9545
Digatron	Joseph S. Lanini	303-455-9545
Digatron	Gary M. Warren	303-455-9545
FCI Constructors, Inc.	Sarah Armstrong	970-535-4725
FCI Constructors, Inc.	Aaron Townsend	970-535-4725
FCI Constructors, Inc.	Bryan Hemeyer	970-535-4725
FCI Constructors, Inc.	Bryan Catterson	970-535-4725
Front Range Excavating, Inc.	Scott A. Nance	303-940-3299
Hensel Phelps Construction Co.	Sarah J. Forrest	970-346-7334
Hensel Phelps Construction Co.	Raymond W. Woodard	970-346-7334
Hensel Phelps Construction Co.	Michelle C. Lepard	970-346-7334
Key Construction, Western Div. Inc.	Eric Hein	303-708-9515
Kiewet Construction Company	Thomas G. Rackley	303-930-9000
Kiewet Construction Company	Michael J. Copack, Jr.	303-930-9000
Kiewet Construction Company	William J. Meysenburg	303-930-9000
Kiewet Construction Company	James E. Wheatley	303-930-9000
Kimsey-Guarentee Electrical Contr.	Zarlene D. Speight	303-373-2400
Kimsey-Guarentee Electrical Contr.	Stephen R. Bolan	303-373-2400
LSB Industries	Michael R. Lemmon	608-784-1124
MODTECH	Brad Archer	281-335-8822
MODTECH	Michael A. Bollero	281-335-8822

MODTECH	Michael D. Bollero	281-335-8822
MODTECH	Stanley Katz	281-335-8822
Mortenson	Jeff Lindsay	303-295-2511
Mortenson	Aaron James Britt	303-295-2511
PCL Construction Services	Michael L. Krickbaum	303-365-6501
PCL Construction Services	Scott Edward O'Hara	303-365-6501
Pride Electric Company	Timothy Craig Murphy	303-433-1494
Riviera Electric	Mark Bearden	303-937-9300
Riviera Electric	Steve Lindquist	303-937-9300
Rocky Mountain Empire Electric	Jerad Charles Madeo	303-471-5675
Rocky Mountain Empire Electric	Damian Gunnar Fesmire	303-471-5675
Rocky Mountain Empire Electric	Gregory Charles Madeo III	303-471-5675
Roy Anderson Corp	Delmar E. Buck, Jr.	228-896-4000
Roy Anderson Corp	David M. White	228-896-4000
Sletten Construction of Wyoming, Inc.	Stephen George Paine	307-634-1477
Swinerton Builders	Dave Beeble	303-423-9242
Tandus/C&A Floorcoverings	Shawn Paul Baker	303-741-0051
West Electric Group	Steven J. Burnett	719-532-0185
West Electric Group	Colby Foos	719-532-0185
WTSC Communications	Melanie S. Hines	719-520-1906